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ABSTRACT

The planning, design, production and presentation of interactive learning exhibits (ILEs) by students in elementary and secondary teaching credential programs provided authentic learning experiences in the integration of computers in teaching and learning settings. This paper includes a rationale and brief overview of the theoretical underpinnings of this approach to technology training, a description of the program, some initial findings, and reflections on successes and challenges. To date this ongoing research and development effort has revealed that engagement in the instructional design and enactment of an ILE can be a rich context for preservice teachers' increased learning about planning, pedagogy, content standards, and assessment in the context of a multimedia learning environment. This work has implications for the preparation of teachers to use computers in classrooms. (Author)

Interactive learning exhibits: Designs for building teacher and student capacity

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The planning, design, production and presentation of interactive learning exhibits (ILEs) by students in elementary and secondary teaching credential programs provided authentic learning experiences in the integration of computers in teaching and learning settings. This paper includes a rationale and brief overview of the theoretical underpinnings of this approach to technology training, a description of the program, some initial findings, and reflections on successes and challenges. To date this ongoing research and development effort has revealed that engagement in the instructional design and enactment of an ILE can be a rich context for preservice teachers' increased learning about planning, pedagogy, content standards, and assessment in the context of a multimedia learning environment. This work has implications for the preparation of teachers to use computers in classrooms.

(Keywords: technology training, preservice teacher preparation, interactive learning exhibits, constructivism.)

A rationale for taking a new approach to technology training in teacher education

The UCI ILE (interactive learning exhibits) project is a response to a continuing problem in technology education: while the number of computers in the classroom has continued to increase, they have not been implemented in teaching and learning at the same rate. Teachers

use computers to produce handouts, record student data, and conduct research on the Internet, while continuing to teach as if these new tools did not exist (Becker, 1998). If we look closely at how teachers are usually taught to use computers, this emphasis on the computer as a productivity tool is not surprising. Meanwhile some educators have been predicting the potential benefits of computers in teaching for some time (Papert, 1980, 1993, Perkins, 1991), and recent research suggests a strong correlation between teachers who use computers in teaching and constructivist practice (Becker, 2001). However, in spite of this evidence and predictions the power of technology to release human potential for teaching and learning has not been fully explored and many remain skeptical of the claims of the benefits of computers in the classroom (Oppenheimer, 1997). We believe that the problems associated with the lack of the use of computers in teaching and learning can be ameliorated by reforming the ways that teachers are taught to use computers. This has been the underlying premise of the interactive learning exhibits project, a new approach to technology training in U.C. Irvine's teacher preparation program, which was developed in collaboration with a U.S. Department of Education PT^3 grant (Preparing Tomorrow's Teachers for Technology). The ILE project addresses the problems associated with computer use for teaching and learning by starting with teaching and learning objectives: teachers decide what students need to know, then design computer-based interactive learning exhibits that engage learners in inquiry and critical thinking, and take advantage of particular learning affordances of multimedia technologies.

Description of the ILE program

The ILE project was implemented as a major component of a 10-week technology course for 120 multiple and single subject credential candidates, in the first half of their teacher

preparation year. (This is a "fifth year" teacher preparation program.) In a project-based learning environment, the preservice teachers worked in teams to solve an instructional design problem. Each team had to conceive, design, construct, and finally enact (with K-12 students) an interactive learning exhibit with the following characteristics:

- **Exhibit as interactive, technology-supported learning environment**. The physical layout of the exhibit area was an instructional space with a teacher computer station, display system and large screen, eight student computer stations, a printer and tables and chairs. Given this layout, the instructional design problem was to create a learning environment where students and one or more teachers would engage in a lesson in which multimedia played a prominent role in supporting the learning and assessment process. Using the authoring program HyperStudio,™ [1] the designers had to create computer-based, multimedia-supported learning activities and employ sound instructional pedagogy that included teacher-directed and guided instruction, student independent practice, student interaction in meaning-making activities that drew on different levels of knowledge and critical thinking, and assessment of learning outcomes.
- **Standards based and assessment-driven instructional design**. Desired learning outcomes were selected from the California frameworks and content standards for a particular subject area and grade level. Multiple subject students designed exhibits with learning outcomes drawn from the history and social studies framework and standards for grades K-6. Single subject students selected learning outcomes from their particular subject area specialization at the middle or high school level. Using the planning model drawn from Wiggins and McTighe's Understanding by Design (1998), desired learning outcomes and assessment

[1] HyperStudio is produced by Knowledge Adventure, Torrance, CA.

strategies were identified first; those decisions drove subsequent instructional activity design decisions.

- **Appropriate and accurate content**. Once learning outcomes and assessment strategies had been identified, preservice teachers had to do research using primary and other source materials to find appropriate content information for their interactive exhibit activities. In many cases, content information was drawn from Internet resources and from books.
- **Testable designs**. The multiple subject student teams that designed interactive learning exhibits also had the opportunity to "test" their instructional programs with K-6 students. With an authentic audience for their instructional products, the preservice teacher designers could evaluate their instructional strategies and the developmental appropriateness of their content, and assess student learning.

A number of support activities were introduced during the ILE project to ensure success as preservice teachers conceived, designed and constructed their interactive exhibits. These included:

- Introduction and/or review of the California frameworks and content standards to aid teachers in understanding the main themes and important ideas that should be considered when planning lessons in a particular subject domain and grade level
- Use of concept mapping software (Inspiration [TM 2]) to identify possible topics and themes for an interactive learning exhibit
- A Design Specification Worksheet to guide preservice teachers through the steps of backwards planning (assessment-driving planning) for their instructional design work and activity planning

[2] Inspiration is produced by Inspiration Software Inc., Portland, OR.

- Use of Inspiration™ [2] software and/or index cards to storyboard interactive exhibit activity screens that would subsequently be developed using HyperStudio™ software.
- Workshop on the use of content from Internet sources: evaluating its appropriateness and accuracy, and copyright considerations
- Workshop to introduce the use of the HyperStudio™ multimedia authoring software
- Use of rubrics with evaluation criteria for peer formative and summative evaluations of the interactive learning exhibits. Categories of evaluation included: instructional design and learning outcomes; subject matter content; professional considerations; technical design; and aesthetic appeal.

Comparison of the new ILE approach to previous, more traditional approaches used by the UCI education department to provide technology training

Previous, more traditional approaches to preparing preservice teachers to use technology in the UC Irvine, Department of Education were designed to satisfy computer education competencies required by the California Commission on Teacher Credentialing from 1988 through 1998. These early courses included lectures and lab work designed for the preparation of elementary and secondary education teachers to use computer-based and related multimedia in the classroom. While the content of the courses changed as technology progressed, for example with the introduction of the Internet as a classroom tool, the format of the discussions, demonstrations and workshops remained largely the same. These included lectures and discussions about the legal and ethical considerations of using computers in the classroom, and workshops in computer operations, productivity tools such as databases, spreadsheets and Internet design software, World Wide Web research, and courseware evaluation. Each of these topics and activities were designed to "stand-alone" and while the students demonstrated these

computer competencies by producing various documents, what was missing was a unifying thread that linked this work directly to instruction.

In December 1998 the California Commission on Teacher Credentialing (CCT) adopted revised computer education competencies, Standard 20.5: Use of Computer-Based Technology in the Classroom: "Effective Use of Computer-Based Technology in the Classroom for Preliminary Multiple and Single Subject Teaching Credentials and Effective Use of Advanced Computer-Based Technology in the Classroom for Professional Multiple and Single Subject Teaching Credentials (CCT, 1998)." Importantly, now the "factors to consider" by CCT evaluators of California teacher education programs, in addition to the traditional areas such as computer operations, productivity tools and legal and ethical considerations, also included wording that pointed to the "effective" use of computers in teaching and learning itself.

Each candidate:

- Identifies student learning styles and determines appropriate technological resources to improve learning,
- Considers the content to be taught and selects the best technological resources to support, manage, and enhance learning,
- Demonstrates an ability to create and maintain effective learning environments using computer-based technology,
- Analyzes best practices and research findings on the use of technology and designs lessons accordingly (CCT, 1998).

The ILE project provided the missing unifying thread and provided the vehicle to address the persistent problem of the ineffective use of computers in teaching and learning while meeting the revised California Commission on Teacher Credentialing standards for computers in

education. In the process of addressing an instructional design problem that required backwards planning to produce and later enact multimedia-based interactive learning exhibits, the preservice teachers also demonstrated requisite competencies: computer operations; use of productivity tools to map topics, collect and organize data and statistics, and produce multimedia; web-searching capabilities; application of legal and ethical considerations; and sensitivity to the diverse backgrounds and needs of learners in technology applications.

Findings about what pre-service teachers have learned as a result of participation in this program

Because we believed that the ILE project provided a context for authentic development of knowledge about pedagogy, planning, models of constructivist learning, content standards, assessment, and other topics central to teacher education, as well as instructional decisions about the use of technologies to support learning, we sought to measure preservice teacher development in several ways. In this paper, we present some initial findings from survey data collected from the multiple subject preservice teachers at beginning and end points of the ILE project.

In pre- and post-ILE project surveys, preservice teachers were asked to rate their confidence about their knowledge and readiness to design an interactive learning exhibit, with respect to the following areas of knowledge:

- Subject matter knowledge of the subject area selected for the ILE
- Knowledge of the California framework and content standards for the subject area selected for the ILE
- Knowledge of the California Standards for the Teaching Profession

- Pedagogical subject area knowledge about effective teaching strategies for teaching the subject area selected for the ILE
- Pedagogical knowledge about general constructivist teacher strategies to foster student learning (for individuals and collaborative groups)
- Pedagogical knowledge about effective lesson planning
- Pedagogical knowledge about effective assessment techniques
- Awareness of the features of HyperStudio software and other multimedia resources that can be incorporated into a teacher's instructional strategies
- Awareness of other resources (non-technology, i.e. books, visual, manipulatives, etc.) that can be incorporated into a teacher's instructional strategies
- Comfort level with using or learning to use software tools and other technology resources

Confidence ratings ranged from 0 (not confident at all) to 4 (Extremely confident). For each area of knowledge listed above, the mean confidence rating increased significantly from the beginning of the ILE project to the end. Figure 1 below summarizes these findings. The largest increases in confidence were for the knowledge areas of a) California framework and **content standards** for the subject area selected for the ILE, b) Pedagogical subject area knowledge about effective **teaching strategies for teaching the content area** selected for the ILE, and c) Awareness of the features of **HyperStudio software and other multimedia resources** that can be incorporated into a teacher's instructional strategies.

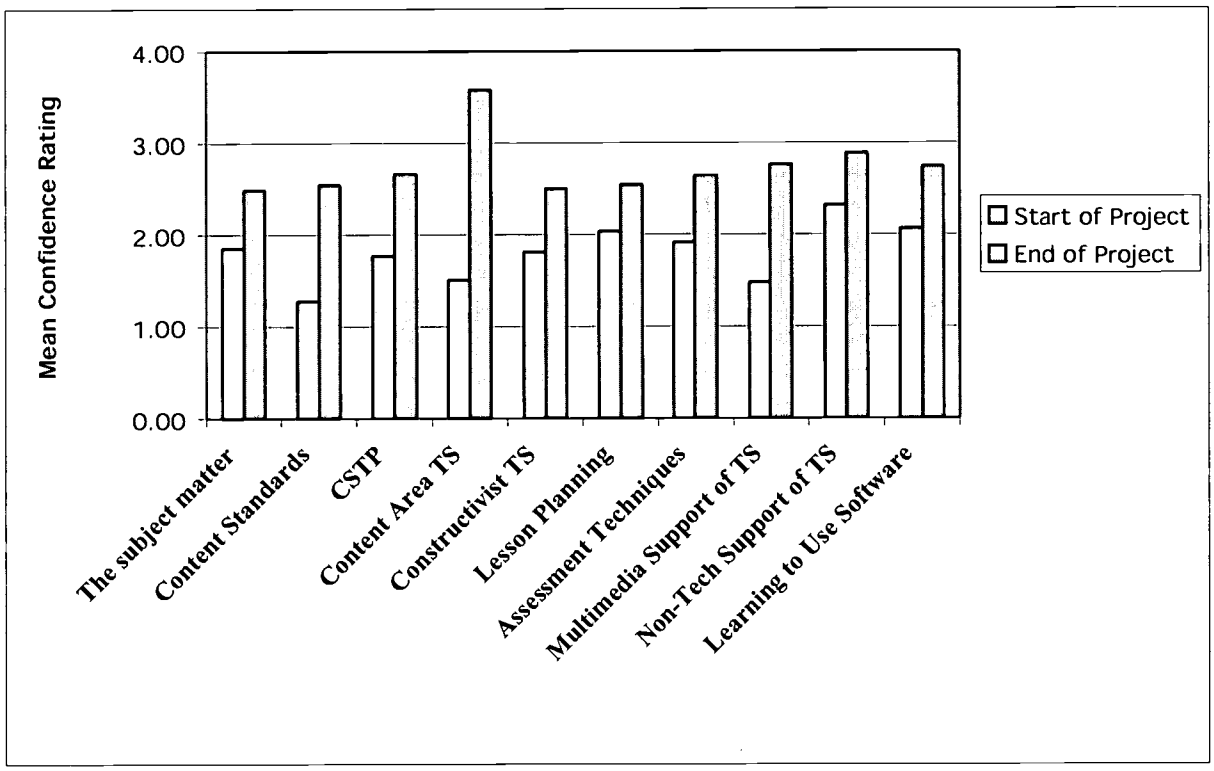

Figure 1: Growth in Confidence in Knowledge and Readiness to Design the Interactive Learning Program with Respect Different Areas of Knowledge.

The survey administered at the end of the ILE project also provided some evidence about increased confidence and positive attitudes of preservice teachers toward the uses of technologies for learning, as a result of their participation in the ILE project. In particular, they were asked to rate how they thought their participation in constructing an interactive learning exhibit had contributed to their confidence in different types of knowledge and skills. Confidence ratings ranged from negative 1 (less confident as a result of participation) to 3 (much more confidence as a result of participation). From a list of sixteen different instruction-related skills and knowledge areas, three in particular had mean confidence ratings of two or better. These were a) abilities to use new computer technologies in teaching, b) beliefs about the potential of multimedia

technologies to be used as effective tools to support learning, and c) abilities to design instruction in the future that makes use of multimedia technologies to support learning.

Finally, the post-project survey also asked students to comment on the most important things that they had learned about teaching and instruction in the ILE project that they thought would be beneficial to them as they started their teaching career. Some comments focused on pedagogical and planning issues; others focused on issues of technology integration. Here are a few examples:

- "This project really hit home the importance of backwards lesson planning; that is, starting with assessment and designing a lesson around that. When put into practice, I see how backwards planning makes for a more effective lesson."
- "Teaching even the most boring topic may be potentially enhanced with the use of technologically advancements through computers, the Internet, etc."
- "I learned not to be afraid to try new things with technology."
- "I know from my own experience that I often don't like reading something that is either too long or too busy. I've learned the importance of aesthetics in presenting material to students. I've also learned the importance of interaction in not only maintaining a student's attention, but also in ensuring their understanding."

Findings about what is needed to help students succeed and learn with the ILE model of technology training

While we are pleased with survey results that provided evidence of students' perceived growth as a result of participation in the ILE project, there are several skill areas that posed difficulties for preservice teachers as they engaged in exhibit design and construction. We believe these difficulties arose because we were working with novice teachers who were still learning about the craft of teaching and principles of learning. They brought with them years of their own experience as learners in classrooms, and some of those experiences pose obstacles for new ways of thinking about multimedia-supported learning activities. One challenging area was that of creating constructive, interactive learning activities in a multimedia, online environment. Preservice teachers were more comfortable with designing HyperStudio screens that presented information (much like a PowerPoint presentation). We observed in our conversations with the preservice teachers about their designs that it was challenging for them to conceive of learning activities that engaged the learners in meaning making (constructing knowledge) or critical thinking. Another challenging area was assessment. While most were familiar with a model of multiple choice quiz questions as a means of assessing factual knowledge, they were much less familiar with "performance assessment" strategies that might allow the teacher to gain other types of insight about learner understanding. This challenge was compounded when preservice teachers had to conceive of such performance assessments in an online environment. Finally, we found that often the preservice instructional designers selected content that was appropriate for a particular age group (based on state content standards), but neglected issues of readability and visual organization appropriate for a particular age level when they designed their HyperStudio

screens. Our recognition of these challenges will lead us to provide additional support to help preservice teachers in these areas next year.

Benefits and constraints of collaborations with methods faculty to integrate technology education into core course work.

During the 2001-2002 academic year, the technology methods faculty met regularly to plan for the new design of the technology courses to reflect these new approaches to preparing the teaching credential candidates to use computer-based technology effectively in teaching and learning. In the elementary education program there was additional collaboration with the history-social science methods faculty member who joined in course planning sessions, made presentations about the history social science framework, provided time in her methods course for the candidates to work on their projects, and provided moral support and feedback to the students on the progress of their ILEs. This interdisciplinary collaboration between faculty, technology and history -social science proved highly desirable. The content area faculty member provided insights to the core content of the ILEs that both enriched the content and made it more authentic to the classroom setting. The limitations on this collaboration were that the planning took considerable time and scheduling busy faculty was an ongoing challenge.

Future directions for this program

We have reason to believe that the ILE approach to preparing teacher candidates is more desirable than the former more traditional, piecemeal approach used in the past. The candidates who produced the ILEs have been prepared to view the array of technology tools and capacities available to them as tools to be implemented in addressing instructional problems. The challenge now is to design a teacher preparation program that can address the limitations of the

2001-2002 ILE program. An important limitation was that the multiple subject education candidates had limited knowledge of instructional planning and assessment when they started the technology course in the first quarter of their 5th year program and this slowed down the progress of their ILE planning. A solution that is under consideration for next year is to expand the ILE activities over a longer period of time, in order to take advantage of growing skills and knowledge that preservice teachers gain in the latter half of the year. Additionally, we intend to provide more scaffolding for skill building in areas of weakness during the beginning of the ILE project. Ideally, this can be done in collaboration with other methods instructors and courses.

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